Annual Report 2015

Genebanks CRP

A. Key Messages

The CGIAR Centers have an obligation to the world to conserve and make available the 35 *ex situ* crop and tree collections under their management according to the provisions of the International Treaty of Plant Genetic Resources for Food and Agriculture (ITPGRFA). The Genebanks CGIAR Research Program (Genebanks CRP) provides security in funding until 2016 to enable the CGIAR to fulfill this obligation by supporting the routine operations of the genebanks. It is a CRP in name only; it does not include research and thus reporting is done in a different format, with performance indicators reflecting the status and use of the genebanks.

Status of the genebanks and distribution of germplasm

The CGIAR genebanks presently manage 750,604 accessions, including 23,529 *in vitro* accessions and 31,069 accessions held as plants or trees in the field. Approximately 74% of total accessions are immediately available for international distribution under the SMTA (Figure 1). This continues the steady increase in the availability of accessions since the CRP was launched in 2012, when 66% accessions were available. A total of 92,236 additional accessions are now immediately available that were not available before, which is particularly significant given that 480,000 samples have been distributed and more than 77,000 accessions have been acquired in the course of the past four years. Of the seed accessions, 53% is secured in safety duplication at two levels, and 73% of accessions of clonal crop collections is safety duplicated in the form of *in vitro* or cryopreserved samples. Currently, 87% of accessions have passport or characterization data accessible online. The level of safety duplication of seed accessions declined in 2015 due to the release of 39,524 accessions from the Svalbard Global Seed Vault for the reconstitution of the active collections at ICARDA in its new genebanks in Morocco and Lebanon. By contrast, a significant increase was achieved in the safety duplication of clonal accessions in 2015 due to increased efficiency of *in vitro* duplication at both CIP and IITA.

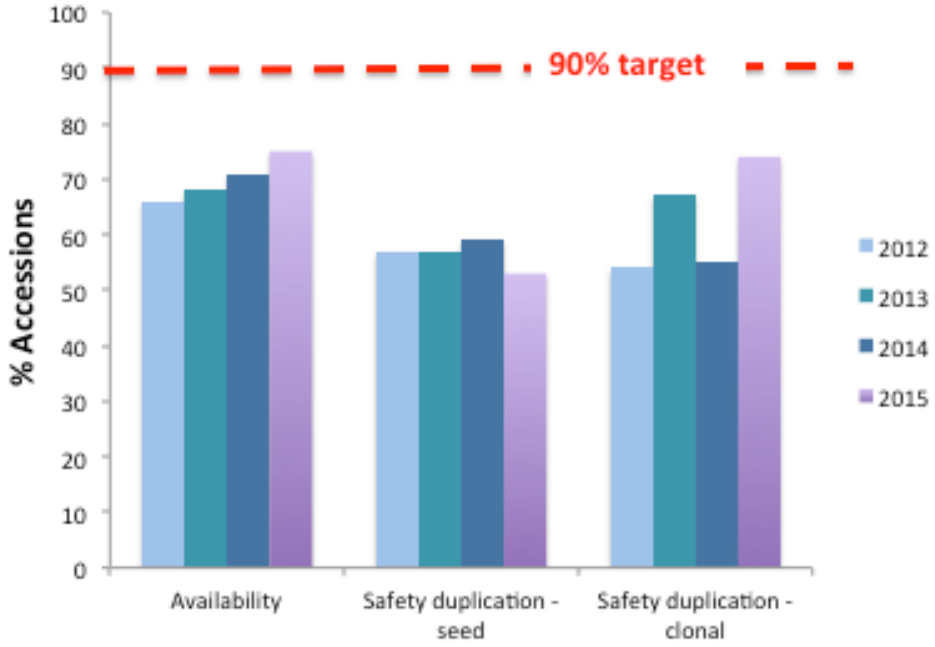

Figure 1. Status of availability and safety duplication of CGIAR genebanks across years.

A total of 91,506 germplasm samples was provided by the CGIAR genebanks to users in 2015; 32,850 distinct accessions were provided to CGIAR Research Programs (CRPs) and 20,010 accessions were distributed outside the CGIAR directly to advanced research

institutes & universities (43%), NARS (32%) and to farmers and the private sector (25%) in 114 countries.

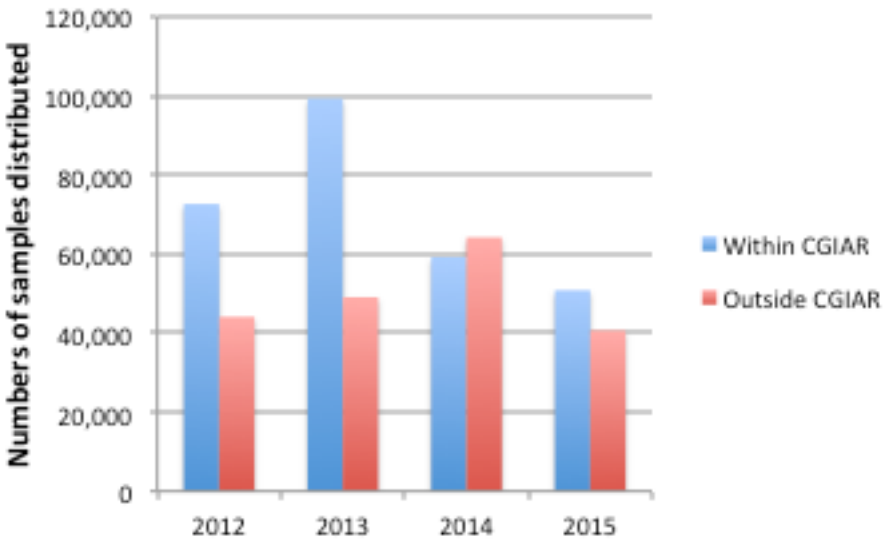

Figure 2. Annual total samples distributed since 2012.

Significant achievements in 2015

Adoption of GRIN-Global software

A highly significant achievement of 2015 is the decision of six genebanks (and potentially two more) to adopt the same accession data management software. GRIN-Global (www.grin-global.org) has been under development for several years and is now fully operational as the prime accession data management system for the USDA genebank system. It provides a powerful, adaptable database model to support all operations in the management of large and complex collections, together with web interface that provides online access and searchability to selected data. CIMMYT was the first Center to decide to adopt the software, in 2013, and consequently provided a frontrunner role to other Centers. Through support and training from the CRP and the Crop Trust, CIP, CIAT, ICRISAT, IITA and ILRI have evaluated different options and decided to adopt GRIN-Global. AfricaRice and Bioversity are continuing their evaluation before making a decision. ICARDA and IRRI have in operation mature data management systems that provide features that would not be readily transferred to GRIN-Global. For instance, IRRI's data management system is embedded with controls to aid workflow and is conversant with IRIS.

The significance of this progress cannot be fully determined until the software is fully operational in all genebanks. No one software package can provide the answers to all of the management challenges and constraints that genebanks face. However, by building a community of adoption and practice not only within the CGIAR, but with major genebanks outside the system (e.g. USDA, Australia), the CGIAR genebanks are able to benefit in multiple ways: facilitated data exchange, instant online presence, and shared development of software advancements, applications and implementation practice. Nearly all externally reviewed genebanks have received recommendations to strengthen their data management systems, and adopting this powerful software is a decisive and positive response both for the individual genebanks and for the CGIAR system as a whole.

Endorsement of the Genebanks CRP by the Fund Council

In response to a request from the Fund Council to present options for funding the genebanks beyond 2016, a proposal was developed by the CO and Crop Trust through a consultative process with all the genebank managers to present three options for funding. The core activities were presented in the form of two options: the first option comprising strictly essential operations and the second including a minimal additional element of collecting, capacity building and outreach. The CO and the Crop Trust presented the paper and the current status of the genebanks at the 13th meeting of the FC in Bogor, Indonesia. The paper was well received and the FC approved the funding of the second option and requested that a component of capacity building and quality management of germplasm health units also be included. Further, they agreed to develop a special funding mechanism that will ringfence support of USD 93.1 million for the genebanks up to 2021. These decisions represent a significant positive step in continuing to ensure the security of funding of the CGIAR genebanks and an endorsement of the work of the Genebank CRP.

B. Progress along the Impact Pathway

C.1 Progress towards outputs (2 pages)

Well-resourced, active genebanks work towards targets of maximum security, availability and use of unique and valuable accessions according to international standards. Genebank activities are not specifically targeted towards specific users or uses, and it is important that they remain flexible to changing needs and demands. The composition, security, availability and use of the collections are, thus, key indicators for the success of the Genebanks CRP.

Progress towards performance targets

All genebanks are actively working towards improving the percentage availability and safety duplication of the collections through seed multiplication, viability testing and disease cleaning. Of the total aggregate collection, 10% were planted out in the field for multiplication or regeneration and slightly more were tested for viability. Ten of 11 genebanks have undergone review by external experts since the beginning of the CRP, and all are now implementing workplans to address key recommendations concerning all aspects of genebank management.

The individual status of the genebanks is provided in Table 1 and for the CRP as a whole across years in Table 2. It is important to note that safety duplication generally occurs in batches of accessions, and takes time. This may lead to annual figures showing a general decrease in % Security as the collection size increases. It is a major achievement that 10 of the 11 Centers have accumulated enough germplasm from regenerations and cryopreservation over the past three years to plan to safety duplicate a total of 79,982 accessions in 2016.

Center	% Availability	% increase from 2014 availability	% Security (SD)	% increase from 2014 security	Comments SD = safety duplication RAP = Recommendation Action Plan
AfricaRice	82	5	40	43	Progress made under RAP
Bioversity	62	2	53	-2	SD decreased because of increase in size of

Center	% Availability	% increase from 2014 availability	% Security (SD)	% increase from 2014 security	Comments SD = safety duplication RAP = Recommendation Action Plan
					collection. New batch of cryopreserved accessions to be duplicated in 2016
CIAT seed	63	15	72	9	Progress made under RAP
CIAT cassava	61	66	33	-3	Increase in available accessions after testing for Frogskin virus. SD depends on annual duplication of in vitro materials in Peru and so varies.
CIMMYT wheat	86	0	60	-2	Collection size increase has lead to decrease in SD
CIMMYT maize	62	-2	29	-3	Accurate data on SD and availability still being resolved.
CIP	17	-6	80	19	CIP is systematically resolving the identity of in vitro accessions, which has lead to loss of availability. SD measures have, however, greatly strengthened.
ICARDA	61	5	51	-35	Accessions removed from Svalbard lead to decrease in SD
ICRAF	39	34	15	150	All field accessions are available locally. Seed collection now being systematically duplicated at Svalbard but given the length of time needed to attain tree seed this process will be lengthy.
ICRISAT	87	5	15	0	In the process of duplicating all seed at first level host as well as at Svalbard.

Center	% Availability	% increase from 2014 availability	% Security (SD)	% increase from 2014 security	Comments SD = safety duplication RAP = Recommendation Action Plan
IITA seed	46	54	47	-6	Safety duplication planned in 2016.
IITA clonal	26	28	64	73	Significant increases in availability and SD.
ILRI	49	11	19	0	Low levels of SD because only 39% is in long-term storage and regeneration of forages is slow. Planning SD in 2017.
IRRI	94	2	91	0	Reaches targets

Table 1. Status of the genebanks with respect to performance targets. Figures are calculated from accession numbers reported in the online reporting tool.

Additional activities

In addition to the routine operations of the genebanks, the CRP proposal envisaged a number of additional activities that contribute to improved conservation methods and genebank efficiency. These activities are as follows:

Cryopreservation

CIP has made major strides in cryobanking on a large scale. A team of technicians has been trained and has established a workflow that allows more than 450 potato accessions to be cryopreserved per year to newly revised and stringent quality standards. This is unprecedented. The average recovery rate of cryopreserved samples increased from 49% (2013) to 59% (2015). The success rate of the current cryopreservation method (defined as the proportion of processed accessions that have more than 30% recovery rate) has increased from 58% to 86% and the proportion of accessions with signs of contamination has decreased from 10% to 6%. A study has been set up to allow the long-term monitoring of cryopreserved accessions over a 50+ year period. CIP and IITA have both installed efficient liquid nitrogen generating plants, which in the case of CIP is already saving costs of USD 18,000 per year.

Additional acquisitions and collecting

Six collecting projects undertaken by five Centers (AfricaRice, CIMMYT, ICARDA, IITA, IRRI) in eight countries (Bangladesh, Benin, Cameroon, DR Congo, Greece, Nepal and Nigeria) are reaching their conclusion. A total of 2,544 accessions of diverse species have been collected in numerous missions. Agroecological zones or habitats likely to harbour specific landraces, crop wild relatives or traits of interest to breeders were targeted using GIS tools and published data. While in several cases collectors were unable to locate specific landraces, probably because they have been lost, there were some notable successes. Through systematic explorations of marginal areas on four islands and three mainland areas in Greece where traditional landraces are still cultivated, the ICARDA missions succeeded in collecting a number of target taxa, including wild relatives and landraces of cereals, legumes,

Indicator	Glossary/guidelines for measuring the indicator	2012	2013	2014	2015	2016	2021
		Actual	Actual	Actual	Actual	Target	Target
1. Total number of accessions	Base number of accessions in the collections of the genebanks. This number was used as the basis of the 2010 Costing Study. It does not include the barley collection at CIMMYT, rice collection at CIAT, Rhizobium collection at ICARDA, nor regional collections of ICRISAT.	710,001	725,244	738,215	750,604	760,000	-
2. Total number accessions that are currently available	Numbers of accessions that are viability tested, disease-free and in sufficient numbers for immediate distribution.	465,358	492,654	525,410	559,053	630,000	>90% of total
3. Number seed accessions held in LTS and safety duplicated at two levels	Numbers of accessions in seed collections held in long-term storage and also safety duplicated in long-term storage in a major genebank in another country and represented in the Svalbard Global Seed Vault.	386,037	375,271	413,448	381,932	524,400	>90% of total
4. Number RTB accessions in cryopreservation and safety duplicated	Number of vegetative-propagated accessions in cryopreservation and also safety duplicated in a major genebank in another country.	2,775	2,699	16,355	20,170	13,412	>50% in cryo by 2025
5. Stage (from 1 to 5) in QMS development	A qualitative assessment of where the genebanks are in the development of their quality and risk management system. Five stages will be described and the Centers will assess themselves		New indicator			Essential components of QMS in place	4 or 5

(online)	and/or through the GeneSys web portal						
7a. Average time from seed harvest to storage	As an illustration of the efficiency of seed processing and conservation, this indicator measures one of the most critical factors affecting seed longevity: the average number of days between last day of harvest and first day of storage in LTS.		New indicator			Target to be determined	
7b. Average time between tissue subculture	A parallel efficiency indicator for clonal crop collections: average number of days between first day of previous culture and day of initiation of new culture.		New indicator			Target to be determined	
8. Number countries receiving germplasm	Aggregated number of countries receiving germplasm from the genebanks	105	122	112	114	No target	No target
9. Number germplasm requests	Total number of legitimate external requests made to the genebank for germplasm. This indicator is intended to illustrate trends in outside interest in the collections but does not include requests where lack of necessary follow up on the side of the requester resulted in the request being dropped.	2,331	1,721	2,054	2,366	No target	No target
10. Number accessions distributed within CGIAR	Number of distinct accessions provided to the host institute or other CGIAR Centers. This indicator reflects the diversity of germplasm being requested.	61,645	67,800	35,167	32,850	No target	No target
11. Number accessions distributed outside CGIAR	Number of distinct accessions provided to users outside the CGIAR. This indicator reflects the diversity of	27,538	30,965	32,625	20,010	No target	No target

	germplasm being requested.						
12. Total number of samples distributed	Number of samples provided to all users. This number reflects the overall quantity of germplasm being requested. Some accessions are requested multiple times. This number does not include DNA samples, which are disseminated by some genebanks (e.g. Bioversity, CIP, etc).	131,181	154,894	123,067	91,506	No target	No target
13. Average overall satisfaction of genebank users	This represents the average score for overall satisfaction (scale of 1 to 7) with genebank services according to surveys returned.		New indicator			Target to be determined	
14. Number accessions in GeneSys	Number of accessions currently held in the GeneSys web portal.	2.35 million	2.35 million	2.7 million	2.6 million		
15. Number users of GeneSys	Number of visitors on the GeneSys web site.	>1000/ mnth	>1000/ mnth	>1000/ mnth	>2000/ mnth		
16. % genebank routine operating costs covered by Trust endowment	Funds provided by the Trust as a proportion of the total routine costs of the 10 genebanks (excluding ICRAF)	16%	17%	15%	17%	17%	

Table 2. Overall indicators across years

vegetables. This included *Trifolium uniflorum*, a drought-resistant species compatible with *Trifolium repens* of which only four genebank accessions are recorded in Genesys.

Optimizing collections

Several Centers are investing funds (complementary to the Genebank CRP) in improving genebank facilities. ILRI commenced a project to replace the pre-fabricated structure that houses the genebank with a permanent two-storey building with offices, laboratories and cold rooms. This includes a biosafety laboratory to support the evaluation of key forages for disease resistance. Through bilateral funding, IRRI built a seed processing facility to house a custom-built automated seed phenotype sorter, which was purchased through the Genebank CRP. Through the funding provided by the CGIAR for decentralization, ICARDA has built and equipped four new cold rooms and two drying rooms in Lebanon and Morocco, together with laboratories and offices, and a greenhouse and more than 100 isolation cages for the regeneration of forages, outcrossing crops and crop wild relatives. Already 36,964 accessions are in storage in these new facilities and a record number of 31,000 accessions are planted out for seed increase at the two sites.

Global outreach and capacity building

The Crop Trust organized a Genebank Operations and Advance Learning (GOAL) workshop for 35 genebank staff from CIMMYT, CIP, CIAT, INIA-Ecuador, INIA-Peru and CORPOICA. The workshop represents the first of a series of five GOAL workshops planned in the framework of QMS strengthening, in which specialized genebank staff share expert practices and knowledge of individual genebank operations, data management and policy implementation. Standards are discussed and modified for eventual incorporation into individual genebank's standard operating procedures (SOPs). This is a key medium for raising and sharing standards and good practice across the system and beyond to national partners.

Studies at IRRI, funded through GRiSP, have identified multiple factors, genetic and environmental, affecting seed storage behavior and longevity. Data suggest that changes can be made in drying protocols to counteract the effects of high moisture content of harvested seed and significant gains can be made in seed longevity if harvested seed is moved into storage with minimum delay. IRRI is improving its operating procedures and efficiency as a result. The Genebank CRP is leveraging this work through an initiative begun in 2015 and led by IRRI, to provide support to other Centers (AfricaRice, CIAT, CIMMYT, ICRAF, ICARDA, IITA and ILRI) in analyzing historic seed longevity data and adapting procedures to increase seed longevity in storage and reduce the need for viability monitoring and regeneration.

Genesys

The global portal for accession data, Genesys (genesys-pgr.org), which features data on all CGIAR genebank accessions, has several new attributes and website layout which allow the display and analysis of genebank metadata. Universally Unique Identifiers with Permanent URLs (PURL.org) were introduced for all accession records and an archive was built to hold and make accessible all deleted records. The Genesys Oversight Committee met in November and established a new terms of reference as the Genesys Advisory Committee.

An automated index is now generated to measure passport data completeness (PDCI[1]). This index uses the presence or absence of data points in the documentation of a genebank

[1] Van Hintum, T. Menting, F and E. van Strien. 2011. Quality indicators for passport data in ex situ genebanks. Plant Genetic Resources 9 (3) pp 478-485. DOI: http://dx.doi.org/10.1017/S1479262111000682.

accession, taking into account the presence or value of other data points. A collection can attain a maximum score of ten. The current average PDCI for the genebanks is given in Table 3. The enrichment of passport data can, thus, be tracked over time through this index.

Center	Average PDCI
AfricaRice	5.62
Bioversity	5.27
CIAT	4.51
CIMMYT	5.30
CIP	5.38
ICARDA	5.83
ICRAF	5.34
ICRISAT	6.05
IITA	4.66
ILRI	6.46
IRRI	5.22

Table 3. Passport data completeness index for CGIAR genebanks.

C. Partnerships building achievements

The CRP organized an international meeting in collaboration with the Crop Trust project on Crop Wild Relatives. The meeting brought together the CGIAR genebank managers and more than 40 NARS collaborators in Izmir, Turkey, to discuss various themes on conservation and use of crop genetic resources.

A consultant hired by the CRP, Bruce Pengelly, led the development of a strategy for the conservation and use of tropical and subtropical forages (TSTF). Twenty national partners were surveyed to collate data on the status of collections, conservation priorities and the role of the CGIAR Centers. Discussions in a workshop in October in Bonn, Germany, with 20 participants resulted in the publication of a strategy document [2], which describes the need to:

- Rebuild the community of TSTF genebanks and genebank users to develop closer collaboration and trust;
- Take steps to ensure more efficient and rationalized conservation within and between genebanks;
- Actively support use by anticipating germplasm needs and responding more directly to users' requests for information and seeds.

A summary of updates on partnerships of individual Centers is provided in Table 4.

Theme	Center	News on partnerships These activities are funded from multiple sources and not necessarily the Genebanks CRP
Conservation in a global system	AfricaRice	• National rice research program of Madagascar is considering duplicating their rice collection at AfricaRice. • Partnership with Nigeria genebank and breeders involving conservation of traditional landraces at AfricaRice.

[2] https://www.croptrust.org/wp-content/uploads/2014/12/Forages-Strategy.pdf

Theme	Center	News on partnerships These activities are funded from multiple sources and not necessarily the Genebanks CRP
	Bioversity	• An MOU was signed between Bioversity, the Norwegian Institute for Agricultural and Environmental Research and Plants Forever, formalizing their mutual interests to develop a cooperation in long term conservation of genetic resources.
	CIAT	• Participated together with the Tropical Forages community in developing a conservation strategy.
	CIP	• Collaboration with the Instituto Nacional de Innovación Agraria-Cusco, using their screenhouses for the regeneration of wild potato germplasm.
	ICARDA	• Participated together with the Tropical Forages community in developing a conservation strategy.
	ILRI	• Support to Ethiopian Biodiversity Institute to advise on construction of their new duplicate genebank.
Improving conservation protocols & capacity to implement them	CIP	• Genna Tesdall, under-graduate student from Iowa University, USA; received training on in vitro in mashua, potato. • Provided training to EMBRAPA-Brazil in December on procedures for evaluating viability status, visual detection of microbial contamination, and to improve environmental conditions for storing the in vitro safety duplicate collection. • Katherine van der Woude, Iowa State University student, received 2-months training on in vitro conservation of sweetpotato • Plant" (IVDP).
	ILRI	• Support to KALRO Genebank of Kenya with capacity development in germination testing.
Phytosanitary	Bioversity	• In partnership with IITA, CIRAD, the University of Queensland, the University of Liege - Gembloux, and Vitropic, Bioversity took part in a task force that developed a strategy for the ITC to distribute eBSV infected germplasm with minimal impact on recipient countries. This agreed strategy will be implemented after all B genome germplasm has been screened, around the end of 2016.
	CIAT	• Cooperation with USDA-APHIS, USA,12 materials sent as controls for different strains of cassava Frogskin virus.
	CIP	• Collaboration with CIP pathologists to publish a paper on "Identification of latent bacteria contaminating in vitro cultures of sweetpotato [Ipomoea batatas (L.) Lam] by PCR", submitted to "In Vitro Cellular and Developmental Biology –
Data management	Bioversity	• An EU-funded MusaNet workshop on plantain characterization and documentation was held at

Theme	Center	News on partnerships These activities are funded from multiple sources and not necessarily the Genebanks CRP
		the Centre Africain de Recherches sur Bananiers et Plantains, in Cameroon in May with the participation of 12 curators from national Musa collections across West and Central Africa, key experts, and staff from CARBAP and Bioversity.
Characterization and evaluation of traits	CIAT	• 238 cassava accessions sent to the Leibniz Institute of Germany as part of a project to find possible resistance against CBSD and CMD. • 2,164 cassava accessions sent to the IAEA, Austria, to look for herbicide resistance and high value starch as part of a project on eco-Tilling.
	ICARDA	• First sources of resistance for Faba bean necrotic virus have been identified by ICARDA virology lab in Tunisia. • Characterization and evaluation of chickpea core collection in collaboration with ICRISAT for major agronomic traits including GBS of 780 accessions. • Evaluation of chickpea FIGS subsets with GRDC-Australia project. • Collaboration with Australian and ICARDA barley breeders in Dryland Cereals CRP to evaluate seven FIGS subsets for resistance to PM, NB, BYDV and for drought tolerance. Several sources of resistance were identified and the seeds were sent to the breeders in Australia. • Collaboration with GRDC-Australia and Tunisia to compare FIGS subsets with GCP subset for disease resistance. FIGS showed relatively higher percent of sources of resistance.
	ICRAF	• Collaboration with CRP4 on Baobab collection and characterization –collection in Mali and characterization currently being carried out.
	ICRISAT	• Provided germplasm including mini core collection, reference set and crop wild relatives for crop improvement / molecular studies, agronomic evaluation, and screening against biotic stresses in Dryland Cereals and Grain Legumes CRPs.
	IITA	• Collaboration with maize breeders to evaluate germplasm in response to MLN. • Evaluation of cowpea wild relatives in collaboration with breeders has identified some accessions with resistance to Striga gesnerioides.
	ILRI	• Joint workshop with Livestock and Fish CRP in March 2015 on Forage and fodder tree selection for future challenges - linking genebanks to users (http://livestock-fish.wikispaces.com/GenebankVC_2015).

Theme	Center	News on partnerships These activities are funded from multiple sources and not necessarily the Genebanks CRP
Providing materials and subsets to breeders	CIAT	• Bean accessions for heat and drought tolerance provided to Grain legumes CRP. • Bean germplasm with high iron provided to HarvestPlus program. • Drought tolerant forage legumes provided to Livestock CRP • Brachiaria germplasm has been provided to the Biological Nitrogen Inhibition project at CIAT.
	ICARDA	• Wheat FIGS subsets and elite lines issued from interspecific crosses were sent to ICARDA breeders in Morocco for inclusion as parental germplasm in the breeding programs. • Partnership with Wheat CRP on 120 interspecific crosses using Aegilops bicornis and Ae. vavilovii in collaboration with INRA-Morocco. • A GCDT-funded grasspea pre-breeding project initiated in collaboration with IPK-Germany, INRA-Morocco, ICAR-India and King Abdallah University-Saudi Arabia.
	IITA	• Working closely with CFFRC on Bambara groundnut, with IITA breeders on soybean and with PhD and MSc students at Nigerian Universities on African yam bean and winged bean.
	IRRI	• Participated in breeders' meetings, and organized the annual genebank open day where we show off the material being regenerated and the newly-received material being grown in the field under post-entry quarantine.
Diversity studies & genotyping	CIAT	• Tepary bean and Lima bean germplasm has been sent to USDA and UC-Davis collaborators respectively for large-scale studies of genetic diversity by GBS.
	CIMMYT	• 30,000 ICARDA wheat safety duplicates held in CIMMYT genebank and additional ICARDA accessions were genotyped by GBS with funding from Wheat CRP.
	CIP	• Collaboration with Australian National University (ANU) to evaluate mutations in Rubisco gene of wild potato species • Collaboration with ANU to skim sequence cultivated potato and evaluate domestication • Collaboration with USDA-ARS and EMBRAPA to compare sweet potato germplasm collections via molecular characterization with SSR markers.
	ICRISAT	• Sequenced finger, foxtail and barnyard millets through GBS, implemented as part of the Dryland Cereals CRP. Barnyard millet core collection

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		sequenced through GBS identified several thousand SNPs, which are useful to analyse population structure and phylogenetic relationships in the collection.
	IITA	• GBS of IITA maize accessions through the Seeds of Discovery pipeline. • GBS and phenotypic analysis of cowpea mini core with breeders and molecular geneticists. • GBS of cassava core collection along with breeders lines in RTB CRP.
	IRRI	• Collaborated in research on sequence diversity of rice funded by GRiSP.
Interaction with farmers	CIMMYT	• In partnership with ICAMEX (Instituto de Investigación y Capacitación Agropecuaria, Acuícola y Forestal del Estado de México), organized farmer field days at Toluca Station, and incremented seed for maize accessions that were selected by farmers. • Participated in "Buena Milpa" project in Guatemala on the conservation and use of native maize in the Altiplano.
	CIP	• 476 cultivated potato accessions were repatriated (1335 samples, 10 tubers per each sample) to 10 rural communities in the Peruvian Andes: Ancash (5) Apurimac (2) and Cusco (3). • Over 50 indigenous farmers representing nine different communities from Parque de la Papa and Lares-Cusco region participated in a CIP-ANDES-INIA one-day workshop on “Climate change and El Niño”.
	ICRAF	• Supplied germplasm to several bilateral projects being carried out with various national partners such as SmAT-Scaling in WCA-Sahel; AFSPII, Evergreen (World Vision) and GIZ PSMNR Project in East and Southern Africa. Also to ICRAF/GIZ PSMNR Project, Vikki Tropical Resources Institute (VITRI), Somalia, IFAD Strengthening Rural Project, Heifer EADD Project.
Climate change	CIP	• Collaboration with NASA to model climate change in Parque de la Papa using their satellite data
Policy	IRRI	• Establishment of an FAO-IRRI agreement on the development of the Global Information System (GLIS) of the ITPGRFA, focussing initially on the use of DOIs as Permanent Unique Identifiers for germplasm.

Table 4. Summary of partnerships in 2015

D. Capacity building

As part of the strengthening of QMS, the QMS specialist, Janny van Beem, visited IRRI, CIAT, AfricaRice and ICRISAT genebanks to work with staff on the mapping of genebank operations and drafting of standard operating procedures (SOPs). The visits involve an intensive effort of all professional staff to document comprehensively the areas of work for which they are responsible, building on all previous available guidelines and published practices. At the same time, Dr van Beem reviews measures to control physical access to the genebank, the comprehensiveness of barcoding, risk management strategies and staff succession plans. She also reviews with the genebank manager the responses to external review recommendations. In 2015, drafts of 17 SOPs were completed by the four Centers visited.

The CRP-funded GOAL workshop held at CIAT and a Crawford Institute-funded GOAL workshop in India, enabled the genebanks and the QMS specialist to discuss standards of operations together with NARS representatives. One of the outcomes has been an interest from NARS to evaluate the QMS strengthening program of the CRP. Dr van Been has since shared templates and approaches or given webinars to staff from the USDA, Australia, Indonesia and Bhutan genebanks.

E. RISK MANAGEMENT

1. ***Capacity to increase availability***: All genebanks are attempting to address bottlenecks that are constraining the rate at which accessions are successfully made available. These bottlenecks occur mainly in health testing and/or regeneration and are due to lack of staff capacity, suitable field sites, screenhouse space or biological factors leading to poor seed production. Some bottlenecks are more easily addressed than others. For instance, IITA has increased availability of cowpea accessions by 41% thanks to funds from GIZ to build a screenhouse and the CRP to hire more GHU staff. In some cases (e.g. some forages in ILRI and CIAT, some chickpea accessions in ICRISAT and some maize accessions in CIMMYT), rates of regeneration cannot be improved without relatively lengthy efforts to identify more suitable field sites for regeneration, or research to improve rates of viable seed production. The proposed dates to reach performance targets for such collections can only be roughly estimated at this stage while these issues (including the legal obligations of the Centers to maintain all such in trust accessions) are fully explored.

2. ***Use of Svalbard duplicates***: The first retrieval of Svalbard duplicates has instigated an exploration of the protocol for requesting and regenerating these demanding accessions. The procedure of retrieval was relatively smooth given that the recipient countries (Morocco and Lebanon) are not the same as the donor country (Syria), which could have potentially raised phytosanitary or other issues. The regeneration of the seeds has also been highly successful despite the occurrence of a devastating drought in the region, but only due to the ICARDA staff going beyond the call of duty to irrigate and care for these materials. The event has triggered a call to consider a special protocol for the retrieval and regeneration of Svalbard deposits given their unique value. This special protocol will be considered and developed as part of the QMS.

3. ***Risk management template***: Several external reviews made recommendations to improve the risk management strategy pertaining to individual genebanks. The 2015

CRP audit also recommended that the risk management template be strengthened. This is an essential element of QMS and is being addressed with each individual genebank. Risk management strategies are uploaded annually in the ORT.

H. LESSONS LEARNED

Analysis of variance from original plans:

i. The Genebanks CRP introduced, for the first time, the practice of reporting numbers of accessions of incoming, processed (viability tested, regenerated, multiplied, etc.) and distributed germplasm for all genebanks in one centralized online reporting tool. Monitoring these figures across years has provided a much more in-depth insight at a system level than has previously been possible into the management of collections and associated data, and the challenges faced by genebank staff. The concentration of the targets to four key parameters ensures that incentives and efforts are focused towards the topmost priorities of ensuring that germplasm in the collections is documented, tested to be healthy and viable and in sufficient quantity to be made available and safety duplicated. This effort alone, considering the size and nature of the collections, is considerable. We feel that these have proved to be strong and appropriate indicators. The indicators are triangulated with data in Genesys and we are considering how this link between the datasets might be strengthened further. In addition, in the second phase of QMS, we plan to independently validate reported accession numbers with seeds in storage on the ground.

ii. The initiation of a systemwide study on historical viability data was delayed for more than six months because of the difficulty IRRI experienced in recruiting staff from what is a very small pool of expertise worldwide. IRRI has now hired someone and plans are in place to carry out the study with six Centers in 2016. Other Centers have also reported the difficulty of hiring expert staff, especially on relatively short-term contracts. Clearly, setting up conservation research projects for a period of less than three-years leads to difficulties in practical implementation and should be avoided where possible.

iii. The monitoring of accession numbers across years has highlighted, both for genebank managers and for the Crop Trust as Project Manager, where interpretation of data and targets is not aligned within and across genebanks. For instance, not all Centers understood that deposition at the Svalbard Global Seed Vault should be at a second level, some Centers had multiple or unclear thresholds for sufficient seed for distribution, some Centers have sought legal clarification on the availability of accessions that are outside of Annex 1 or non-food or feed, etc. The ORT reporting has brought these issues to the forefront and ensured that they are better addressed. This is a positive outcome leading to stronger alignment across the genebanks.